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## Household waste behaviours among a community sample in Iran: An application of the theory of planned behaviour



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### ABSTRACT

Understanding the factors influencing recycling behaviour can lead to better and more effective recycling programs in a community. The goal of this study was to examine factors associated with household waste behaviours in the context of the theory of planned behaviour (TPB) among a community sample of Iranians that included data collection at time 1 and at follow-up one year later at time 2. Study participants were sampled from households under the coverage of eight urban health centers in the city of Qazvin. Of 2000 invited households, 1782 agreed to participate in the study. A self-reported questionnaire was used for assessing socio-demographic factors and the TPB constructs (i.e. attitude, subjective norms, perceived behavioural control, and intention). Furthermore, questions regarding moral obligation, self-identity, action planning, and past recycling behaviour were asked, creating an extended TPB. At time 2, participants were asked to complete a follow-up questionnaire on self-reported recycling behaviours. All TPB constructs had positive and significant correlations with each other. Recycling behaviour at time 1 (past behaviour) significantly related to household waste behaviour at time 2. The extended TPB explained 47% of the variance in household waste behaviour at time 2. Attitude, perceived behavioural control, intention, moral obligation, self-identity, action planning, and past recycling behaviour were significant predictors of household waste behaviour at time 2 in all models. The fact that the expanded TPB constructs significantly predicted household waste behaviours holds great promise for developing effective public campaigns and behaviour-changing interventions in a region where overall rates of household waste reduction behaviours are low. Our results indicate that educational materials which target moral obligation and action planning may be particularly effective.

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### 1. Introduction

The increasing production of household waste is one of the effects of population growth, rising living standards, rapid development and urbanisation (Mahar et al., 2007). Household waste is generally defined as waste that is produced by normal household activities (Mbande, 2003). Household waste is one of the major sources of municipal solid waste to which most costs of municipal waste management are allocated (Karak et al., 2012). Globally, the waste management sector is faced with numerous challenges including the increasing amount and complexity of waste (Webster, 2012). This problem leads to a multitude of environmental hazards such as infectious diseases, environmental degradation,

water and soil pollution, greenhouse gas emission and negative impacts on the quality of human life (Miller, 2000). These problems are more common and visible in developing countries, where garbage collection operations do not occur at all or not enough. One solution for overcoming problems associated with overloaded landfills is recycling (Ehrampoush and Baghianimoghadam, 2005). Recycling is a process whereby materials that have been used previously are collected, processed, re-built and re-used (Rudnick, 2008). Despite the fact that more than half of all solid waste is recyclable, studies indicate that a considerable amount of recyclable waste is dumped into the garbage (Mancini et al., 2007).

In the developing country of Iran, much attention has been given to the environmental effects of municipal waste over the last several years (Abduli et al., 2007). Studies show that a relatively high volume of waste is generated in most provinces and cities of Iran (Nasrabadi et al., 2008). For example, 320 kg of solid waste is generated annually by each citizen in Tehran city. In other

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words, each person produces trash equal to 6 times his/her own body weight. However, the volume of waste generated by Iranians is nearly half that of European countries and the United States where annual per capita solid waste ranges from 410 kg to 760 kg (Karak et al., 2012). Due to a lack of funding for waste transfer and a lack of public participation in recycling activities, disposal of household waste is a growing concern in Iran (Nasrabadi et al., 2008). In Iran, only 8% of municipal waste is recycled and the remaining waste is buried using unhygienic methods. In contrast, 80% of municipal waste is recycled and returned to the consumption cycle in most developed countries. However, in Australia and the United Kingdom, only 60% of household waste is recycled (Jamshidi et al., 2011).

In a study from Iran, it was revealed that accumulation of waste in the KAHRIZAK disposal site in Tehran has led to groundwater and soil contamination as well as outbreaks of several diseases including cholera and cutaneous leishmaniasis (Nasrabadi et al., 2008). One way to alleviate deleterious impacts of landfills is to minimise the generation of waste. Cost-effective techniques for minimising waste include public education and citizen encouragement to share in the design of household recycling processes (De Feo and De Gisi, 2010). Furthermore, the success of household recycling programs strongly depends on citizens' participation in the source separation process which requires people to separate special products from their household wastes (Krook et al., 2007). Ultimately, understanding the behavioural and psychological factors influencing household recycling activities can lead to better and more effective recycling programs in the community. Such information is critical in informing governmental strategies for waste management and solving household waste problems (Kofoworola, 2007; Rahardyan et al. 2004; Wilkinson, 2007).

There is a need to test and conduct theory-based studies to understand the mechanisms responsible for recycling behaviours. Several behaviour change theories have been applied to explain the factors influencing recycling behaviour, including Schwartz's Norm Activation model (Van Liere and Dunlap, 1978), the theory of reasoned action (Ajzen and Fishbein, 1980), and the theory of planned behaviour (Ajzen, 1991). The theory of planned behaviour (TPB) provides a theoretical framework to systematically examine factors that affect behavioural change. According to the TPB, a person's behaviour is based on his/her readiness to perform a given behaviour (i.e., intention). The TPB considers intentions as the immediate antecedent of behaviour. Intention is based on attitudes toward the behaviour (the degree to which performance of the behaviour is positively or negatively valued), subjective norms (the perceived social pressure to engage or not to engage in a behaviour), and perceived behavioural control (people's perceptions of their ability to perform a given behaviour; Ajzen, 1991). Perceived behavioural control (PBC) not only predicts behavioural intention but also can be used, together with intention, to predict behaviour. The TPB has been widely used for different behaviours such as physical activity, oral health, and healthy eating (Dunn et al., 2011; Pakpour et al., 2011, 2012). Furthermore, the TPB has been supported for recycling behaviours among university staff (Karim Ghani et al., 2013), households (Bortoleto et al., 2012; Davis and Morgan, 2008), university students (Ramayah et al., 2012) and contractors (Begum et al., 2009). The TPB is a parsimonious model to explain an individual's behaviour, as supported by a meta-analysis (Armitage and Conner, 2001).

Despite the theoretical support of the TPB for recycling behaviours, there is a need to devote much more attention towards identifying factors which influence recycling behaviours within the context of the TPB (Ajzen, 1991). Several studies have recommended adding further variables to improve the predictive validity of the TPB. For example, self-identity is defined as the salient part of an actor's self that relates to a particular behaviour and can be

thought of as the extent to which performing the behaviour is an important component of the person's self-concept (Conner and McMillan, 1999). There is some evidence that self-identity can be used to successfully predict behavioural intention beyond the components of the TPB in recycling behaviour (Nigbur et al., 2010; Terry et al., 1999).

Studies have revealed that subjective norms are considered to be the weakest predictor of behavioural intention in the TPB (Armitage and Conner, 2001). Ajzen also affirmed this problem in the TPB and recommended that moral obligations or moral norms be added to improve the predictive validity (Ajzen, 1991). An individual's perception of the moral correctness or incorrectness of performing a behaviour is considered moral obligation (Ajzen, 1991). Moral obligation was found to be a significant predictor of recycling behavioural intention among undergraduate students in the United States (Largo-Wight et al., 2012). In another study, waste prevention behaviour was influenced by perceptions of moral obligation among households in São Paulo, Brazil (Bortoleto et al., 2012).

In an empirical review of the TPB literature, it was revealed that strong intention is not sufficient to performing a given behaviour (Sheeran, 2002). Action planning was therefore introduced to bridge the intention-behaviour gap (Sniehotta et al., 2005). Action planning is a self-regulation strategy that translates good intention into action by specifying when, where, and how to act. Action planning is considered to be a post-intentional volitional process that helps to initiate an intended action. Several studies have shown that action planning has an effective influence on performing a given behaviour (Pakpour et al., 2011, 2012; Pakpour and Sniehotta, 2012; Sniehotta et al., 2005). Past behaviour may also be an important predictor of intention and behaviour (Sommer, 2011), but few studies have examined this with respect to household waste behaviours (Miafodzyeva et al., 2013).

To the best of our knowledge, no study has investigated long-term household waste behaviours within the framework of the TPB. Furthermore, to the best of our knowledge, ours is the first study to investigate the association between the volitional process (action planning) and long-term household waste behaviours. The goal of this study was to examine factors associated with household waste behaviours in the context of the TPB among a community sample of Iranians that included data collection at time 1 and at follow-up one year later at time 2.

## 2. Method

### 2.1. Study area

Qazvin (36° 15' 44" N, 50° 1' 0" E) is the largest city and capital of the Province of Qazvin in Iran. Qazvin is located 150 km (93 mi) northwest of Tehran. The population of Qazvin in 2011 was 540,187, with 276,070 males and 264,117 females. Approximately 31% of the population is under 20 years old. Qazvin is an important industrial center and thus its population has increased significantly from 88,000 in 1966 to 540,187 in 2011. In line with this increasing population, a significant amount of solid waste has been generated. Presently, the waste density ranges from 120 kg/m<sup>3</sup> to 470 kg/m<sup>3</sup>. The waste generation rate is estimated to be 709 g/person/day for Qazvin city, which is comparable to other metropolitan areas in Iran such as Tehran (Abdoli, 2000) and Rasht (Alavi Moghadam et al., 2009). According to the waste management law in Iran, each municipality is responsible for all of its wastes, excluding industrial and special wastes (Islamic Parliament, 2004). In Qazvin, the executive agency is the Qazvin Municipality Residues Management Organization (QMRMO). The QMRMO was established in 2005 and source separation programs have started to reduce the volume of

waste. However, there is a crucial need to improve citizen participation in the waste management programs in Qazvin.

## 2.2. Participants

The present study was conducted between July 2011 and December 2012. Health care services are delivered by a health care network in Iran. In Qazvin city, there are eight urban health centers. Each urban health center provides primary health cover for approximately 12,000 people in a given district. These centers gather, record and keep health and demographic information on their populations and are supervised by the Qazvin University of Medical Sciences. For this study, 250 health files were randomly selected from each of the eight urban health centers. Once the sample was identified, all 2000 households were contacted in person by research assistants and asked to complete a self-report questionnaire. A brochure describing the study objectives, the interview and examination process, and study confidentiality was supplied in the initial contact. The household member primarily responsible for managing the household waste was asked to participate and sign an informed consent form. Participants received \$5 for participation in the study.

## 2.3. Measures

A self-report questionnaire was used for this study. Socio-demographic factors included age, gender, marital status, years of education, presence of children in household, and occupational status.

To assess the TPB constructs (i.e., attitude, subjective norms, perceived behavioural control, intention), the items were developed according to the TPB guidelines (Ajzen, 2013) used in previous studies (Cheung et al., 1999; Chu and Chiu, 2003; Nigbur et al., 2010). All measures were presented to the participants in a mixed order to reduce adjoining perceptions on items measuring the same construct. The mean of the respective items were considered to be the direct measure of the corresponding variable.

### 2.3.1. Attitude

Attitude towards recycling of household waste was measured by eleven 5-point evaluative semantic differential scales. "Recycling of household waste every time would be: unpleasant–pleasant, good–bad, harmful–beneficial, favourable–unfavourable, wise–foolish, awful–nice, correct–incorrect, unenjoyable–enjoyable, satisfying–unsatisfying, useful–useless, happy–unhappy. The internal consistency for this scale, as assessed using Cronbach's alpha, was 0.84.

### 2.3.2. Subjective norms

Subjective norms were captured with four items (e.g., "Most people who are important to me think that I should recycle my household waste"). Each item was rated on a 5-point scale from 1 (*strongly disagree*) to 5 (*strongly agree*). Cronbach's alpha for this scale was 0.81.

### 2.3.3. Perceived behavioural control

Three items were included to capture perceived control over recycling (e.g., "It is up to me whether or not I recycle household waste every time I have it for disposal"). This construct was measured on a 5-point scale with endpoints from 1 (*strongly disagree*) to 7 (*strongly agree*). Cronbach's alpha for this scale was 0.90.

### 2.3.4. Moral obligation

Moral obligation was assessed using three items (e.g., "It is moral to recycle household waste") on a 5-point Likert-type scale of 1 (*strongly disagree*) to 5 (*strongly agree*). Cronbach's alpha for this scale was 0.79.

### 2.3.5. Self-identity

Self-identity was assessed with four items (e.g., "I consider myself an energy-saver"). Responses to the items were rated on a 5-point scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Cronbach's alpha for this scale was 0.87.

### 2.3.6. Behavioural intention

Intention to recycle household waste was measured using three items (e.g., "In my household, I intend to recycle my garbage over the next year"). Responses were measured on 5-point Likert-type scale ranging from 1 (*unlikely*) to 5 (*likely*). Cronbach's alpha for this scale was 0.93.

### 2.3.7. Action planning

We adapted four items from Sniehotta et al. (2005) and Pakpour et al. (2011, 2012) to measure action planning on recycling behaviour. The items have a stem "I have made a detailed plan regarding" that was followed by four specific plans that included (a) when to recycle household waste, (b) where to recycle household waste, (c) how often to recycle household waste, and (d) how much time to recycle household waste. Each response was scored on a 5-point Likert-type scale ranging from 1 (*totally disagree*), to 5 (*totally agree*). Cronbach's alpha for this scale was 0.91.

### 2.3.8. Past behaviour

A single item was used to measure past recycling household waste behaviour. Participants were asked to indicate the frequencies of recycling on a 5-point Likert-type scale ranging from 1 (*never*) to 5 (*frequently/at every collection*).

### 2.3.9. Behaviour

After one year (time 2), participants were asked to report their behaviours for each of 8 recycling behaviours. The question, "In the past year, how often did you perform the following recycling behaviours?" was followed by "paper/card/cardboard", "electronic materials", "food waste", "recyclable plastic deposit bottles/jars", "cans/tins", "metal", "refillable glass/plastic", and "textiles" using 5-point Likert-type scales varying from 1 (*never*) to 5 (*frequently/at every collection*). The total household waste behaviour score on this index could range from 0 to 40. A high total score indicated a high level of recycling behaviour.

## 2.4. Procedure

Each participant who gave his/her written consent and read the brochure of the study's aim completed a baseline questionnaire (time 1) that included the aforementioned socio-demographic items and TPB constructs (i.e., attitude, subjective norm, perceived behavioural control, self-identity, moral obligation, action planning, past recycling behaviour). The questionnaires were completed in the participants' houses with two research assistants. One year later (time 2), participants were asked to complete the self-reported recycling behaviour questionnaire. The study procedure was approved by the Ethics Committee of the Qazvin University of Medical Sciences.

## 2.5. Statistical analysis

Descriptive statistics were performed to investigate participants' characteristics. Chi-square and t-test analyses were conducted to compare characteristics between participants and non-participants and also between those who were lost to follow-up. Zero order correlations were used to examine socio-demographic factors that were significantly related with household waste recycling behaviour at time 2. Each significant correlation



between demographic and household waste recycling behaviour was considered to be a potential confounder in the main analysis.

A hierarchical multiple regression was performed in which household waste recycling behaviour was regressed onto the TPB constructs as well as socio-demographic variables. Demographic variables (including gender, age, and education) were first entered as control variables as well as the past household waste recycling behaviour. In the second step, attitude, subjective norms, PBC, moral obligation, and self-identity were included in the model. At step 3, behavioural intention was added. Action planning was entered to the model at the final step. According to the recommendation of Aiken and West (1991), standard scores were used to estimate main effects in this study. Multicollinearity was checked by examining the variance inflation factor scores for the linear regression of the predictors (independent variables). A value <1.5 indicates no existence of severe multicollinearity. The data were analysed using SPSS 16.0 for Windows.

### 3. Results

Of 2000 households originally approached for this study, 218 (10.9%) refused participation. A total of 1782 households participated in the study. Mean age of participants was  $31.74 \pm 12.7$  years and ranged from 20 to 68 years. Sixty-three percent of the participants were female. Approximately 65% ( $n = 1163$ ) of the participants were married. Ninety-six (5.4%) participants did not

complete the follow up questionnaire at time 2. There were no significant differences between participants and non-participants in terms of socio-demographic characteristics. Socio-demographic characteristics of the sample are summarised in Table 1.

Zero-order correlations were calculated to explore the relationships between demographic and TPB variables. Only age, years of education, and gender were significantly correlated with past and follow-up household waste behaviours. Recycling behaviour increased with increased age ( $r = 0.29$ ,  $p < 0.001$ ) and education ( $r = 0.32$ ,  $p < 0.001$ ). Furthermore, an independent  $t$ -test was used to test for the effects of gender on both past and follow-up household waste behaviours. The results indicated that men performed household waste behaviours more frequently than women at both time 1 and time 2 ( $p < 0.05$ ). Therefore, age, gender and education were controlled for in subsequent analyses.

Table 2 shows the bivariate correlations between the TPB constructs and behaviours. As expected, all TPB constructs had positive and significant correlations with each other ( $r$  ranged from 0.19 to 0.67). Recycling behaviour at time 1 (past behaviour) significantly ( $r = 0.67$ ,  $p < 0.001$ ) related to household waste behaviour at time 2 (i.e., one year follow-up). As Table 2 indicates, the means of all TPB variables were equal to or higher than the midpoint scale with the exception of action planning. Regarding the recycling behaviours, the mean of past household waste behaviour (time 1) was lower than the midpoint of the scale while the mean of household waste behaviour at follow-up (time 2) was slightly higher than the midpoint of the scale.

To assess the predictive validity of the TPB constructs over a one-year period, a hierarchical regression was employed. The results revealed that, in Step 1, gender, age, education and past recycling behaviour were collectively able to explain 31.2% of the variance in household waste behaviour at time 2 ( $p < 0.001$ ). Inclusion of attitude, subjective norms, PBC, moral obligation and self-identity at Step 2 contributed a further significant increase in 13.7% of the variance explained in household waste behaviour at time 2 ( $p < 0.001$ ). In Step 3, intention was added, which explained an additional 0.9% of the variance ( $p < 0.001$ ). In the final step, action planning accounted for an additional 1.2% of the variance in household waste behaviour at time 2 ( $p < 0.001$ ). In total, the extended TPB was able to explain 47% of the variance in household waste behaviour at time 2 (Table 3). Moreover, age was a significant predictor of household waste behaviour at time 2 in all models while gender was not significant in the first 2 models.

### 4. Discussion

We used the TPB as a framework to understand household waste behaviours in Iran. As suggested by Conner and Armitage (1998), we used an expanded model of the TPB to determine if past

**Table 1**  
Demographic characteristics variables of the study participants.

| Variables                                    | ( $n = 1782$ )    |
|--|-------------------|
| Age (Mean $\pm$ SD)                          | $31.74 \pm 12.76$ |
| Gender [ $n$ (%)]                            |                   |
| Male   | 660 (37.0%)       |
| Female                                       | 1122 (63.0%)      |
| Marital status [ $n$ (%)]                    |                   |
| Single                                       | 504 (28.3%)       |
| Married                                      | 1163 (65.3%)      |
| Divorced/Widowed                             | 115 (6.4%)        |
| Years of education (Mean $\pm$ SD)           | $7.52 \pm 4.26$   |
| Presence of children in household [ $n$ (%)] |                   |
| Yes  | 1119 (62.8%)      |
| No   | 663 (37.2%)       |
| Occupational status [ $n$ (%)]               |                   |
| Unemployment                                 | 197 (11.0%)       |
| Housewife                                    | 681 (38.2%)       |
| Employee                                     | 452 (25.4%)       |
| Retired                                      | 235 (13.2%)       |
| Others                                       | 217 (12.2%)       |

**Table 2**  
Correlations between the theory of planned behaviour variables at time 1 and 2.

|        | 1 | 2      | 3      | 4      | 5      | 6      | 7      | 8      | 9      | M     | SD    |
|--------|---|--------|--------|--------|--------|--------|--------|--------|--------|-------|-------|
| 1. A   | 1 | 0.41** | 0.44** | 0.36** | 0.57** | 0.49** | 0.31** | 0.54** | 0.47** | 3.70  | 0.66  |
| 2. SN  | – | 1      | 0.39** | 0.33** | 0.46** | 0.37** | 0.40** | 0.24*  | 0.34** | 3.07  | 0.72  |
| 3. PBC | – | –      | 1      | 0.52** | 0.46** | 0.49** | 0.34** | 0.51** | 0.48** | 3.44  | 0.79  |
| 4. MOB | – | –      | –      | 1      | 0.38** | 0.54** | 0.25** | 0.43** | 0.54** | 3.56  | 1.27  |
| 5. SI  | – | –      | –      | –      | 1      | 0.37** | 0.28** | 0.45** | 0.48** | 3.48  | 0.93  |
| 6. I   | – | –      | –      | –      | –      | 1      | 0.32** | 0.49** | 0.54** | 2.55  | 1.16  |
| 7. AP  | – | –      | –      | –      | –      | –      | 1      | 0.19*  | 0.26** | 2.42  | 0.74  |
| 8. PB  | – | –      | –      | –      | –      | –      | –      | 1      | 0.67** | 2.21  | 1.07  |
| 9. RB  | – | –      | –      | –      | –      | –      | –      | –      | –      | 24.40 | 11.93 |

Notes: A: attitude, SN: subjective norm, PBC: perceived behavioural control, MOB: moral obligation, SI: self-identity, I: intention, AP: action planning, PB: past recycling behaviour, RB: recycling behaviour at time 2.

\*\*  $p < 0.01$ .

\*  $p < 0.05$ .

**Table 3**

Hierarchical linear regression of recycling behaviour at time 2 onto age, gender, years of education, past recycling behaviour, attitude, subjective norms, perceived behavioural control, moral obligation, self-identity, intention, and action planning.

|                               | $\beta$ | $R^2$ change | F change | SE    |
|-------------------------------|---------|--------------|----------|-------|
| <i>Step 1</i>                 |         |              |          |       |
| Age                           | 0.025*  |              |          | 0.011 |
| Gender                        | −0.031  |              |          | 0.203 |
| Years of education            | 0.078   |              |          | 0.075 |
| Past behaviour (time 1)       | 0.566** | 0.312**      | 12.321   | 0.114 |
| <i>Step 2</i>                 |         |              |          |       |
| Age                           | 0.112** |              |          | 0.004 |
| Gender                        | 0.071   |              |          | 0.072 |
| Years of education            | 0.011   |              |          | 0.027 |
| Past behaviour (time 1)       | 0.235** |              |          | 0.048 |
| Attitude                      | 0.116** |              |          | 0.041 |
| Subjective norms              | 0.115   |              |          | 0.046 |
| Perceived behavioural control | 0.226** |              |          | 0.042 |
| Moral obligation              | 0.452** |              |          | 0.091 |
| Self-identity                 | 0.206** | 0.137**      | 75.562   | 0.045 |
| <i>Step 3</i>                 |         |              |          |       |
| Age                           | 0.120** |              |          | 0.004 |
| Gender                        | 0.073*  |              |          | 0.066 |
| Years of education            | 0.037   |              |          | 0.026 |
| Past behaviour (time 1)       | 0.175** |              |          | 0.045 |
| Attitude                      | 0.101*  |              |          | 0.038 |
| Subjective norms              | 0.107*  |              |          | 0.042 |
| Perceived behavioural control | 0.174** |              |          | 0.040 |
| Moral obligation              | 0.346** |              |          | 0.092 |
| Self-identity                 | 0.141*  |              |          | 0.044 |
| Intention                     | 0.240** | 0.009**      | 8.901    | 0.074 |
| <i>Step 4</i>                 |         |              |          |       |
| Age                           | 0.112** |              |          | 0.003 |
| Gender                        | 0.075*  |              |          | 0.056 |
| Years of education            | 0.055   |              |          | 0.022 |
| Past behaviour (time 1)       | 0.141** |              |          | 0.041 |
| Attitude                      | 0.101*  |              |          | 0.032 |
| Subjective norms              | 0.153** |              |          | 0.038 |
| Perceived behavioural control | 0.145*  |              |          | 0.035 |
| Moral obligation              | 0.360** |              |          | 0.079 |
| Self-identity                 | 0.173** |              |          | 0.038 |
| Intention                     | 0.282** |              |          | 0.064 |
| Action planning               | 0.127** | 0.012**      | 16.044   | 0.020 |

Notes:  $R^2 = 0.47$ .

\*  $p < 0.05$ .

\*\*  $p < 0.01$ .

behaviour, attitude, subjective norms, perceived behavioural control, moral obligation, self-identity, intention, and action planning measured at time 1 predicted household waste behaviours at time 2, one year later. Our results showed that the expanded TPB constructs, in addition to age and gender, were significant predictors of behaviour and explained 47% of the variance in the model. Our findings are comparable to previous studies of household waste behaviours in the United Kingdom (Davis and Morgan, 2008), United States (Largo-Wight et al., 2012), Hong Kong (Cheung et al., 1999), Cuba (Mosler and Martens, 2008), and Malaysia (Ramayah et al., 2012), demonstrating the universality of the TPB to predict household waste behaviours despite differences in culture and waste management infrastructure between developed and developing nations. The increased ability of the expanded TPB to predict recycling behaviour in our study reinforces the importance of utilising additional measures beyond intention, attitude, subjective norms, and perceived behavioural control as appropriate. In particular, action planning significantly contributed to the predictive ability of our model and thus we recommend that this relatively under-studied measure be used in future studies of household waste behaviour.

Moral obligation was the strongest predictor of household waste behaviours in our study, having a larger regression coefficient than all other TPB constructs at each step in our model. This

finding is consistent with previous studies (Miafodzyeva et al., 2013) and suggests that strategies which emphasise individuals' intrinsic and moral motivations to recycle will be important in promoting household waste reduction behaviours. Such strategies may be particularly effective in Iranian cities such as Qazvin, where we measured an overall low level of household waste reduction behaviours. This result is unexpected, given the infrastructure available for recycling household waste in Qazvin. Kerbside pick-up for paper, glass, plastic, and aluminium is performed weekly throughout the city at no charge to residents. Other studies have reported that availability of kerbside recycling is one of the strongest influences on recycling behaviour (Derksen and Gartrell, 1993; Mosler and Martens, 2008) and thus it is unlikely that the low rate of household waste reduction behaviours in Qazvin is attributed to inconvenience. Furthermore, participants in our study scored high for perceived behavioural control, indicating that recycling was generally not perceived to be a difficult or inconvenient task.

In Iran, recycling is mandated under the waste management law which states that the federal government has responsibility for protecting the environment from the harmful effects of waste. This includes setting standards and making policies for recycling and reduction of waste, the production and consumption of goods that are more easily recyclable, and increasing the use of recyclable raw materials in production. Furthermore, the law mandates that mass media (e.g., the Islamic Republic of Iran Broadcasting Organisation), along with educational and cultural organisations, are responsible for publicizing and training citizens on proper recycling practices (Islamic Parliament, 2004). Thus, Iran has a framework in place for encouraging household waste reduction behaviours, including a requirement for education. However, implementation of these efforts will not be successful if public participation is low (Karim Ghani et al., 2013).

Public participation may be improved through campaigns that emphasise individuals' moral obligations to practice recycling and other household waste reduction behaviours. Such campaigns should also emphasise the positive aspects of recycling (attitude), the ability of individuals to recycle (perceived behavioural control), and include strategies for developing a household recycling plan (action planning). Action planning may be encouraged by including a card with the household refuse bill that encourages household members to write down a plan that includes where to store the bins, responsible family member(s), and when to set the bins at the kerb. Social marketing, or focussing strategies on population segments that are most likely to change their behaviours, is another potential mechanism for improving participation in household recycling (Barr, 2008). Application of this approach would require a follow-up study in which behavioural and attitudinal factors are assessed in order to separate participants into discrete segments or clusters; targeted waste reduction strategies could then be developed for each population segment. However, this approach should be used cautiously when applied broadly to household waste behaviours as the multidimensionality of the related but distinct factors of recycling, reusing, and reducing waste may make it challenging to develop effective strategies for discrete population segments (Barr et al., 2013).

We found age and gender to be significant predictors of household waste behaviours. Similar to previous studies (Davies et al., 2002; Pearson et al. 2012; Swami et al., 2011), age exhibited a positive relationship with household waste behaviours. This may be attributed to an increased amount of time available for older persons to perform household waste reduction behaviours or an increased desire to conserve resources for future generations. Disseminating educational materials at post-secondary institutions and creating advertisements which target younger generations are possible strategies for increasing participation in household

recycling among younger age groups. In contrast to prior studies (e.g., Davies et al., 2002), we found that men were more likely to recycle than women. This indicates that, in Iran, targeted educational materials should be developed to encourage women to participate in household waste reduction behaviours. As our sample population was drawn from patients receiving primary health care services from the urban health centers in Qazvin, such educational materials could be made available to women when attending health care appointments.

We had a high participation rate (90%) and a low rate of loss to follow-up (5%). Our high participation and retention rates may be attributed to our data collection method whereby research assistants personally visited households. This contrasts to previous studies that have disseminated surveys via mail and reported much lower participation rates of  $\leq 50\%$  (Bortoleto et al., 2012; Davies et al., 2002). As a result of the high participation rate in our study, it is unlikely that our sample was biased towards individuals already engaged in household waste reduction behaviours. This in turn may help to explain the relatively low level of household waste reduction behaviours reported in our sample as compared to other studies that had lower participation rates but higher rates of household waste reduction behaviours (Davies et al., 2002).

Although our TPB constructs were strong and significantly predicted household waste behaviours, our study is not without limitations. First, we used self-report as a proxy for actual behaviour. It is possible that we overestimated participation in household waste behaviours, as declared behaviour does not always reflect actual behaviour and may lead to overestimation (Barr et al., 2001). However, self-report is the most commonly used measure of household waste behaviour (Miafodzyeva et al., 2013) and comparisons between actual and self-reported behaviours are correlated and likely to be proportionally accurate (Barr et al., 2001; Gamba and Oskamp, 1994). Furthermore, using observed or measured behaviour instead of self-report restricts sample size and would have been logistically challenging in our study of >1700 households. Second, we used one measure to assess recycling and reuse behaviours. Although a prior study found these measures to be highly correlated and likely to be indistinguishable from a lay-person's perspective (Swami et al., 2011), it is possible that waste prevention behaviours (i.e., reusing, reducing) are influenced by different constructs than recycling (Barr et al., 2001, 2005; Barr, 2004, 2007; Bortoleto et al., 2012; Tonglet et al., 2004). In particular, persons in developing nations may exhibit increased rates of reusing or repurposing of waste (summarised in Pearson et al., 2012) as opposed to recycling of waste. Future work should determine if this compensates for the overall low rate of recycling in developing vs. developed nations. Third, we studied influences on household waste behaviour in one urban area of Iran and thus our findings may have limited generalizability to other regions and cultures. Finally, despite the success of the TPB in our study, the large sample size and follow-up data required to fully examine the TPB may not be possible or appropriate in all cases. In addition, other studies suggest that there are other variables, which are not completely covered by TPB, that impact household waste behaviours. For example, habit, access, convenience, and knowledge have been found to exert important influences on recycling behaviour and should be examined further (Barr, 2004, 2008; Tudor et al., 2011; Itiravivongs, 2012). As an alternative to the TPB, Barr (2007, 2008) proposed a new conceptual framework whereby behaviour is predicted by behavioural intention and situational and psychological factors, and intention is in turn predicted by environmental values and situational and psychological factors. This flexible framework enables addition or removal of variables according to the situation at hand and should be considered in future studies.

## 5. Conclusion

We found that attitude, subjective norms, perceived behavioural control, moral obligation, self-identify, intention, action planning, and past behaviour significantly predicted household waste behaviours in Iran. Our study was unique because it was based on a large, community-based sample in a developing nation, included a follow-up survey of household waste behaviour, and included the little-studied constructs of action planning and past behaviour (Miafodzyeva et al., 2013). The fact that the expanded TPB constructs significantly predicted household waste behaviours holds great promise for developing effective public campaigns and behaviour-changing interventions in a region where overall rates of household waste reduction behaviours are low. Our results indicate that educational materials which target moral obligation and action planning may be particularly effective.

One reason for the steady increase in generation of waste worldwide is inadequate participation by individuals in household waste reduction behaviours (Bortoleto et al., 2012). Future studies should focus not only on identifying factors associated with household waste reduction behaviours, but also on designing, implementing, and measuring the effectiveness of public campaigns and interventions. Such efforts are particularly important in developing nations where waste management may be inadequate and the effects of poor sanitation and overfull landfills may have serious consequences for public health (Mosler and Martens, 2008). On a global scale, increased participation in household waste reduction behaviours is a crucial component of decreasing greenhouse gas emissions and combatting climate change (Bogner et al., 2007). Recycling is not enough to minimise greenhouse gas emissions. Emphasis should be placed on promoting waste prevention at the “upstream” level of production and manufacture in addition to waste minimisation “downstream” at the consumer level through recycling, reuse, reduction, and repair (Barr, 2004; Barr et al., 2005, 2013).

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